

these services are provided by service providers WAN (WAN service providers), such as telecom operators. WAN data-link protocols describe how frames are carried between systems on one data link. These include protocols to ensure the work of the service through the two-point and multi-point communications as well as service multiple access dial-type Frame Relay.

Because of the high cost of infrastructure, there is an urgent need for transmission over a single network of all types of traffic, resulting in the company. To support multimedia traffic types are special technologies: ISDN, B-ISDN.

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### **ADVANCING MULTI-MODAL TRANSPORTATION SYSTEM BY SOLVING COMPLEX LOGISTICS PROBLEMS WITH MULTIPLE ARTIFICIAL INTELLIGENT SYSTEMS**

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The railway transportation system, which has become more information intensive, more global and more technologically dependent, is undergoing colossal changes. The role of logistics is also becoming more and more important. In logistics, the objective of service providers is to fulfill all customers' demands while adapting to the dynamic changes of logistics networks so as to achieve a higher return on investment. In order to provide high quality service, decision support systems become extremely and vitally important at proceeding of planning and scheduling of rail carriages. In particular, artificial intelligence (AI) technologies have achieved significant attention for enhancing the agility of supply chain management, as well as logistics operations. A multi-artificial intelligence system is to provide quality logistics solutions to achieve high levels of service performance in the logistics industry. The new feature of this agile intelligence system is characterized by the incorporation of intelligence modules through the capabilities of the case-based reasoning, multi-agent, fuzzy logic and artificial neural networks, achieving the optimization of the performance of organizations.

Multi-modal transportation is a logistics problem in which a set of goods have to be transported to different places, with the combination of at least two modes of transport, without a change of container for the goods. The main goal of this paper is to introduce TIMIPLAN, a new application to solve multimodal transportation problems. TIMIPLAN has been developed in the context of a research project

involving one of the biggest Spanish companies in intermodal transportation, Acciona Transmediterránea Cargo [1]. The main challenge of this project is the size of the planning problems: more than 300 containers, trucks, locations and services have to be dealt with every day. Thus, internally, TIMIPLAN combines Operational Research (OR) techniques with Artificial Intelligence (AI) planning in order to obtain good quality plans, by exploiting the benefits of both kinds of techniques.

There is an initial set of transportation requests, and for each request (or service) a route must be generated. Each transportation request specifies the locations where the goods need to be picked up and locations where they are to be delivered. A service time is associated with every pickup and delivery location that indicates the time at which the corresponding location is available for the pick-up or delivery service. In addition, there are trucks and containers. To complete a transportation route only a container is required, but it can be moved by using combinations of trucks, trains and/or ships. If a truck is used, it should travel to pick the container up, and either visit all locations of the transportation request (picks up and delivery locations), or transport it to the next transportation means (train station or port). The resulting plan should satisfy the given service times of the locations. For instance, if the truck and container arrive early, they have to wait at the location until it is available. If the truck and container arrive late, there will be a cost penalty. In multimodal transportation several trucks are usually needed.

There has been Linear Programming (LP) combined with automated planning techniques in order to obtain good quality solutions. The direct use of classical LP techniques is difficult in this domain, because of the non-linearity of the optimization function and constraints; and planning algorithms cannot deal with the entire problem due to the large number of resources involved. A new hybrid algorithm, combining LP and planning to tackle the multi-modal transportation problem, exploiting the benefits of both kinds of techniques is considered.

The planning component of TIMIPLAN consists of two phases: in phase one, for each set of goods to be picked up and delivered, the containers and trucks with minimum estimated cost to complete the service are selected. In this phase, several assignment models are constructed and solved as linear programming problems. In phase two, an Artificial Intelligence (AI) planner is used to select the best (cheapest) plan to serve each service: from a first pick-up point to the last delivery point over the transportation route. The plan should fulfill a given set of constraints (temporal and regulatory), and will include the sequence of the transportation modes to be used. Although some of the application areas addressed in AI and Operations Research (OR) are very similar (e.g., planning, scheduling), the methods that are used to solve these problems are substantially different.

In a planning context, TIMIPLAN receives the positions of the set of all available resources as input (initial state), a number of services to be performed (goals) and has to generate a plan with actions including: the load of goods in different places; the unload on others; and the assignment and movement of the available resources (trucks, containers, ships, trains etc) to complete this request. Also, it must take into account several constraints, such as pick-up and delivery

times. The objective is to minimize the cost of servicing all the daily requests.

Let us describe the algorithm. First, we compute the assignment of trucks and containers to services taking into account the initial positions of the trucks and containers, using a LP approach. Then, our approach sequentially solves the problem, using three different steps for each service. In step one, the container and truck/s with minimum cost estimated to complete the service are selected. In step two, a planning module is used to select the best path from a first pick-up point to the last delivery point over the transportation route. In this case, best means that the path fulfills the given set of constraints, including the sequence of the transportation modes used (where several trains and/or ships can be used) with the minimum cost. This two-step approach balances the total cost obtained and the time required to compute the plan. The network graph is the graph defined by the locations (pick-up and delivery nodes, positions of trucks, containers, train stations and ports) and edges (roads, rails and ship lines). In step three, we update the assignment of trucks and containers to services taking into account the final position of the trucks and containers used to complete the last planned service. In the third step, we use the same LP approach again.

As it might be seen, a planning problem is built for each service and the planner must select the best transportation modes to complete it. Moreover, the planner must schedule each pick-up and delivery according to the constraints. This planning task has several features that make it very hard for current planners. For example, they are as following:

- Time management: the existing temporal restrictions in the problem (each pick-up and delivery is scheduled according to the time service of each location) imply that we need an explicit management of the current time. If a truck arrived early to a pick-up or delivery point, it must wait, and when it arrives later, a penalty cost is applied. In addition, a container must wait at stations and ports for the next departure of the train or ship. We use fluents to define and handle the temporal aspect.

- Management of functions: in this domain, we use a large number of functions. Some examples are: cost per kilometer when truck travels with/without a container, time spent loading/unloading a container in a train or ship, or time spent by a train or ship to go from a location to another. In addition, other functions are used to limit the driving and resting times of drivers.

- Locations: AI should indicate how to go from one place to another, so information about the transportation map should be added to the problem description including distances, and cost per edge.

Overall, we have introduced an example of AI system TIMIPLAN that successfully solves big multi-modal transportation tasks. Multimodal transportation usually involves the combination of a large number of resources, together with temporal constraints, resource consumption, cost functions, etc. Another key issue in relation to solving real world problems consists on the difficulty of modeling. As future work, we are able to plan the task of combining LP and automated planning in a different way to find better solutions (lower cost) in less time.

## References

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## ARCHITECTURAL AND SPATIAL ENVIRONMENT DEVELOPMENT IN HISTORIC CITIES

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Any architectural landmarks lose their visual appearance with time, the architectural and special compositions need improvement related to the social life modernization. Timely reconstruction of the city environment allows contemporaries live in a comfortable and esthetic environment, but on the other hand, it gives an opportunity to keep the historic heritage for future generations.

The specific feature of the reconstruction in historic cities is that the functional, spatial and designing requirements submit to preservation and revival of the historic architectural and spatial environment as well as the artistic characteristics of the objects.

The concept reconstruction means renewal and improvement. In the context of the historic environment, the concept 'reconstruction' covers the following two different activities:

1. reconstruction of the city, architectural complex, buildings and structures caused by new living standards;
2. archeological restoration of architectural monument, settlement, city, etc.

The latter activity does not necessarily mean a practical realization; it is only a research result. Such a restoration is manifested in the description, in the image (graphic reconstruction) or in the model (scale model).

Forming of a historic city, the scheme of its plan mostly depended on the natural characteristics, namely, the relief, availability of water reservoirs, etc. They played a decisive role in choosing the place for settlement. Natural landscape is one of the main factors for forming the town planning and development. Later, the construction of a building came into certain relationships with the surrounding environment. The building could be balanced with the nature or it could visually suppress it. The vertical organization is important for the spatial structure of historic cities. The city silhouettes were satiated with high dominants, which provided forming of the main accents in the city environment. This system of dominants made a specific visual and informative framework of the historic city.